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Resistance

One of the top priorities in our crops research nowadays is breeding for resistance to diseases and other pests.

Of the 90 new crop varieties released cooperatively by USDA and State experiment stations last year, more than half were developed with specific disease resistance in mind. This same consideration played an important part in the 100 new breeding lines that were released for use by public and private plant breeders in building new varieties and hybrids.

Actually, it's hard to think of a commercial crop that doesn't have some kind of disease resistance bred into it, because such work goes back more than half a century. If you're familiar with crops research, you know that plant breeders repeatedly saved the oat crop from disease—three times over a 20-year period. You know how new durum wheats were rushed into being just in time to meet the threat of devastating race 15B of the stem rust fungus a few years ago.

Recent gains against common smut of wheat (page 5) are partly due to resistant varieties. We're a step ahead of hoja blanca disease of rice because researchers set out to discover sources of resistance even before the disease invaded this country (March 1960, p. 3). A breakthrough in basic research on flax rust has just given us new understanding of plants' resistance to disease (April 1960, p. 3).

Along with gains against disease, we've also had success in breeding crops with resistance to insects. We have wheat resistant to the hessian fly and wheat stem sawfly, corn resistant to the European corn borer and corn ear worm, and alfalfa resistant to the chinch bug and spotted alfalfa aphid.

Among the immediate challenges is the soybean cyst nematode. We are trying to hold it with quarantines while scientists search for ways to eradicate it. If we can't achieve eradication, our best long-term hope is resistant varieties. Plant breeders have found resistant material and are well along in transferring the resistance to commercial varieties. We should have nematode-resistant soybeans in about 4 years.

Such work not only helps protect past gains but also leads to increased efficiency and stability in future production.

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COMING: NEMATODE-RESISTANT SUGARBEETS

Geneticists are hoping to introduce nematode resistance into sugarbeets by manipulating chromosome number. Chemical treatment of plant material doubles chromosome number, thus facilitating successful crossing

■ Viable hybrids from crosses between sugarbeets and related wild species have been obtained by a scientist collaborating with USDA, opening the way to development of commercial sugarbeet varieties resistant to the sugarbeet nematode.

This significant accomplishment was made by cytogeneticist Helen Savitsky of the Beet Sugar Development Foundation, working under ARS supervision at Salt Lake City, Utah.

The sugarbeet nematode. one of the most serious pests of sugarbeets, occurs in all the major sugarbeet-producing areas of the world. All cultivated beets are susceptible. Three vinelike relatives, *Beta patellaris, B. procumbens,* and *B. webbiana,*

COMING: NEMATODE-RESISTANT SUGARBEETS

(*Continued*)

which are native to the Canary Islands and Morocco, are resistant, but most previous attempts to transfer resistance from these wild species to sugarbeets have been unsuccessful. The hybrids either died before flowering because of poor root development or were completely sterile.

Attempts to overcome these problems have been made by various workers. Mature hybrids have been obtained by grafting hybrid seedlings to sugarbeet stock. Swiss chard and other close relatives of sugarbeet have been used in efforts to transfer resistance from the wild species.

But Mrs. Savitsky obtained viable hybrids directly from crosses between sugarbeets and wild species. Increasing the chromosome number of the sugarbeet made the difference.

The sugarbeet (*B. vulgaris*) is a diploid plant—it has the usual two sets of heredity-bearing chromosomes, one set from each parent. Tetraploid sugarbeets—plants with four sets of chromosomes—were produced by treating diploids with colchicine to match the number of the wild relative *B. patellaris*. Colchicine increases the chromosome number by interfering with cell division, and plants of many chromosome levels result. The tetraploids were selected by cytological examination.

Hybrids produced after treatment

Four out of eight tetraploid strains produced successful hybrids with *B. patellaris*. Tetraploid sugarbeets were also mated successfully with the other two wild species, which are diploid. The hybrids from the latter crosses are triploid—they have three sets of chromosomes.

Both triploid and tetraploid F_1 hybrids of sugarbeets are semi-fertile—they did not produce viable pollen, but did set seed when pollinated by diploid and tetraploid sugarbeets. The first backcross generation has been grown from this seed.

Mrs. Savitsky believes the likelihood of transfer of nematode resistance to sugarbeets is greater in polyploid plants than in diploid hybrids. In a study of chromosome behavior in sterile diploids, she and ARS plant pathologist J. O. Gaskill found that the development of pollen and egg cells was very irregular; in fact, some cells contained only a few of the chromosomes of each parent.

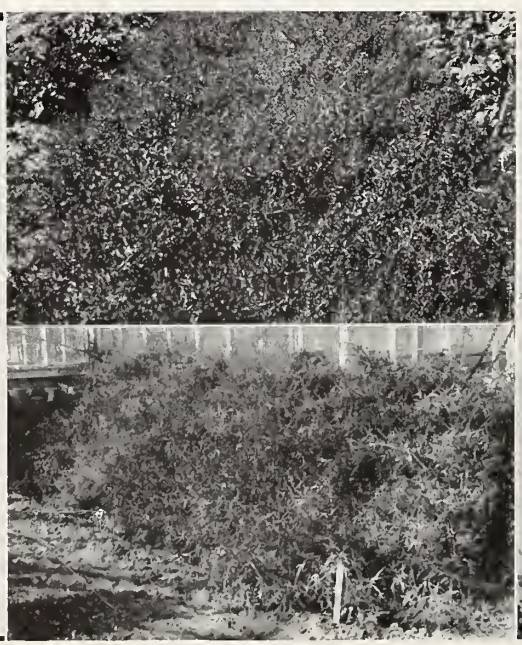
Tetraploids are more compatible

The tetraploid sugarbeets are apparently more compatible with wild species than are diploids. And because more chromosomes are involved in inheritance, there is a better chance that the chromosome segment carrying resistance to the nematode can be incorporated in sugarbeets.☆

There's little resemblance between cultivated sugarbeet, Beta vulgaris *(1), and nematode-resistant relatives* B. patellaris *(2) and* B. webbiana *(3). F_1 tetraploid hybrids (4) carry resistance but look like wild species. Transferring resistance takes continued backcrossing.*

1

2



3

4

Resistant varieties and chemical treatment of seed form the backbone of a

TWO-WAY EFFORT STOPPING SMUT IN WHEAT

Picture that's almost out of date in the Pacific Northwest—combine raising a cloud of smut spores in heavily infected wheat field.

■ Chemical seed treatments and resistant varieties are enabling impressive gains in the battle against common smut of wheat in the Pacific Northwest.

Smut incidence in 1959 was the lowest since record taking began nearly 40 years ago, dropping to 0.5 percent from a high of 34 percent as recently as 1955.

The smut organism, a durable fungus now believed to comprise 28 races with different infective abilities, is still capable of causing damage, but continued control efforts should keep losses at a minimum.

The decline of common smut beginning in 1956 coincides with the development of improved chemical seed treatments by the USDA Regional Smut Research Laboratory, Pullman, Wash., and with the rise in popularity of such highly resistant wheat varieties as Omar, Brevor, and Burt. Breeding of these varieties was under the leadership of ARS agronomist O. A. Vogel. Omar, the most extensively grown variety at present, was released cooperatively by the Washington, Oregon, and Idaho Agricultural Experiment Stations in 1955.

Study of the chemical that proved so effective in controlling smut began in 1952. ARS plant pathologists C. S. Holton and L. H. Purdy, Jr., found formulations containing hexachlorobenzene (HCB) killed *soilborne* as well as *seedborne* spores of the smut fungus when applied to the seeds before planting. Soilborne spores have been a special problem in the Pacific Northwest and infections are controlled only by hexachlorobenzene. Seedborne spores can be controlled by various chemicals.

HCB was evaluated in regional nurseries in Oregon, Washington, Idaho, Utah, and Montana, and in commercial fields. Present recommended seed treatment is to apply HCB formulations containing 40 percent or more active ingredient at the rate of 1 or more ounces per bushel of seed to cover each kernel thoroughly. The scientists believe it's the vapor of HCB that inhibits germination of fungus spores in the soil near treated seeds.

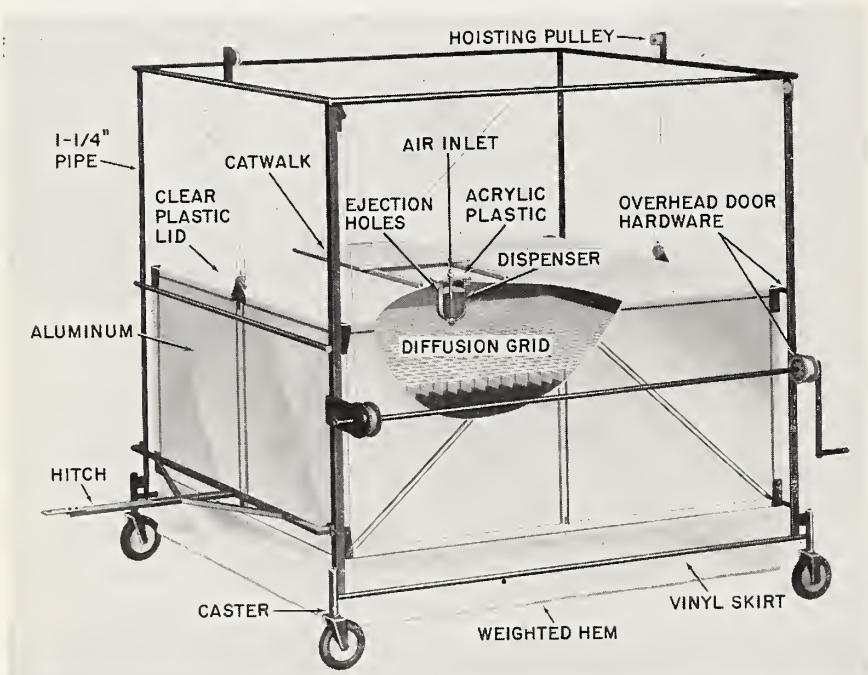
Scientists keep constant vigil on smut fungus

Scientists at the Smut Research Laboratory conduct annual surveys for new races of the smut fungus, maintain cultures of known races, test the reaction of breeding material, and study the life cycle of the fungus and the effectiveness of chemical treatments in a continuing effort to keep smut under control.

Losses from smut result not only from reduced yield but from higher processing costs for spore-covered kernels. The fungus infects seedlings, lives within the growing plant, and eventually replaces developing wheat kernels with smut balls containing millions of spores. The spores are easily spread to healthy kernels and to the soil when smut balls are broken in combining. ☆

NEW RESEARCH TOOL WILL HELP SCIENTISTS

Box equipped with baffles and compressed air is used to distribute dusts accurately and evenly



Compressed air directed into dispenser through air inlet blows dust out of ejection holes drilled around top of dispenser. Diffusion grid deflects dust to insure complete, even coverage.

Small tractor pulls placement box to the field and from plot to plot, also carries tank of compressed air. Device is suspended in frame, can be raised or lowered. Scientists wear protective clothing when using radioactive dusts.

■ Accurate and even placement of dusts on 6- by 8-foot test plots is possible with a new tool developed by USDA agricultural engineers.

An aluminum dust-placement box suspended within a frame that rolls on caster wheels has been designed and built by ARS agricultural engineers P. E. James and J. F. McConnell. The box can be raised and lowered in the frame. A 12-inch vinyl skirt is suspended around the bottom of the box to insure against leakage, an important consideration especially when radioactive materials are used. The bottom of the skirt is held down by steel balls or sand in the hem.

The device was specifically designed to apply dustlike radioactive glass beads 18 to 40 microns in diameter (25,000 microns = 1 inch). Compressed air is directed into the device to blow dust through a series of baffles designed to get the accurate, even distribution and placement desired. This was needed in research on ways to decontaminate agricultural lands in case of excessive radiation from fallout of a nuclear explosion. ARS soil scientists R. G. Menzel and H. Roberts, Jr., cooperated in the removal research.

Also called a portable environmental enclosure, this equipment might have many other uses, such as:

—A safe means of foliar application of tracer isotopes. For this type of application, it might be desirable to substitute plastic for the aluminum walls to admit sunshine and leave the box over the test plot during the entire time of the study.

—A safe means of applying tracer isotopes for study of soil erosion, or the action of tillage machinery.

—Testing the effectiveness of various concentrations of insecticides, rodenticides, miticides, soil disinfectants, plant hormones, etc.

—Testing the effect of smog and other gases on vegetation.☆

GYPSUM FOR SULFUR DEFICIENT SOILS

Relatively inexpensive carrier of this important plant nutrient produced increased yield of rose clover in lysimeter study on San Joaquin Experimental Range

■ It may be practical to overcome sulfur deficiency in some soils by applying such inexpensive sulfur carriers as gypsum, according to State-USDA researchers.

The difficulty lies in selecting the proper source, rate, and frequency of sulfur fertilization for best returns. Some guides are being obtained, however, from plants growing on lysimeters in basic investigations by the California Agricultural Experiment Station and ARS on the San Joaquin Experimental Range, Calif. Long-range studies have just been completed on the fate of sulfur applied as gypsum to an annual legume, rose clover, on Vista sandy loam. Results should be especially useful in California, where sulfur deficiency on range and dry-farmed land is widespread. (Legumes respond to sulfur fertilization especially well.)

Sulfur leached out rapidly in the treated rose clover plots. More was recovered in the percolate than was applied. Additional sulfur came from rainfall—a surprisingly high 21 pounds per acre. A smaller amount—0.1 pound—came from absorption from the atmosphere.

Reconstituted soil profile tested in lysimeter

Cooperating ARS plant physiologist C. M. McKell and agronomist W. A. Williams of the California station used lysimeters 74 inches in diameter with side walls 25 inches deep. Each contained a conical bottom 8 inches deep, drained by a polyethylene pipe.

A soil profile of Vista sandy loam was reconstituted up to 24 inches deep in the lysimeters. Lysimeters were treated with 100, 200, or 300 pounds of gypsum per acre. Radioisotope S^{35} was incorporated into the fertilizer so the applied sulfur could be traced and distinguished from that from natural sources. Lysimeters were then seeded with inoculated rose clover, which was later harvested at full bloom for yield determination.

The sulfur was rapidly lost from all treated plots in the first percolate from winter rains—the more gypsum applied, the greater the loss. But as the rainy season progressed, the rate of sulfur loss gradually declined. And by the end of the season, about the same amount had been leached out in all lysimeters.

Rainfall carries sulfur from air to the soil

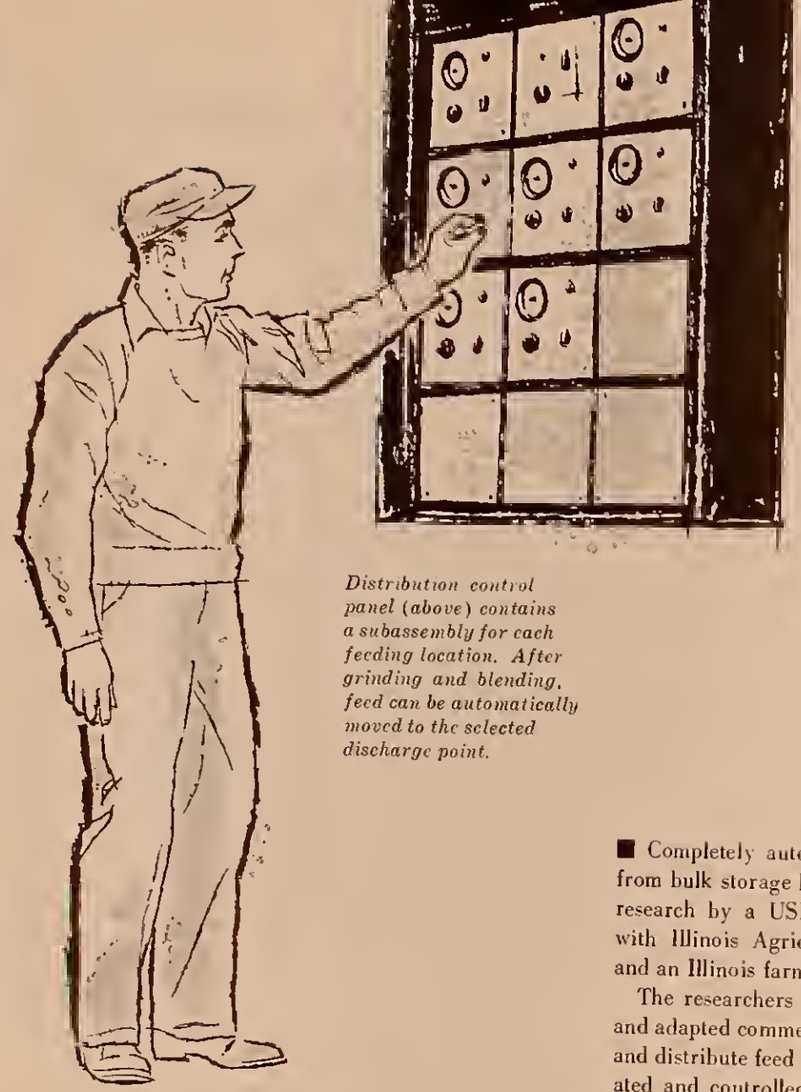
Concentration of sulfur in rain ranged from a low of 0.5 parts per million to a high of 4.7 p.p.m. Surprisingly, the sulfur content of the rain was as high in the last storms of the season as in the first. This is contrary to the common belief that sulfur concentration is high in the first fall rains and then declines as sulfur in the air is washed out by additional storms.

Clover growth was stimulated by the gypsum applications. Yields were much greater on soil given 200 and 300 pounds of gypsum per acre than on soil given 100 pounds or none at all. There was no increase in the sulfur content of the plant tissues—as normally happens when gypsum is added to sulfur-deficient soil—because most of the sulfur had leached out by the time the clover started to make fast spring growth.

Radioassay indicated that clovers grown on soil treated with 100 pounds of gypsum per acre obtained an average of 30.8 percent of the sulfur in the gypsum. With 300 pounds of gypsum, the rate was 57.4 percent.

The scientists warn that gypsum may be subject to much leaching loss during a wet year. High applications intended to last for several years could be lost as easily as lower ones intended to last for only a year. Further study under less intense rainfall is desirable.

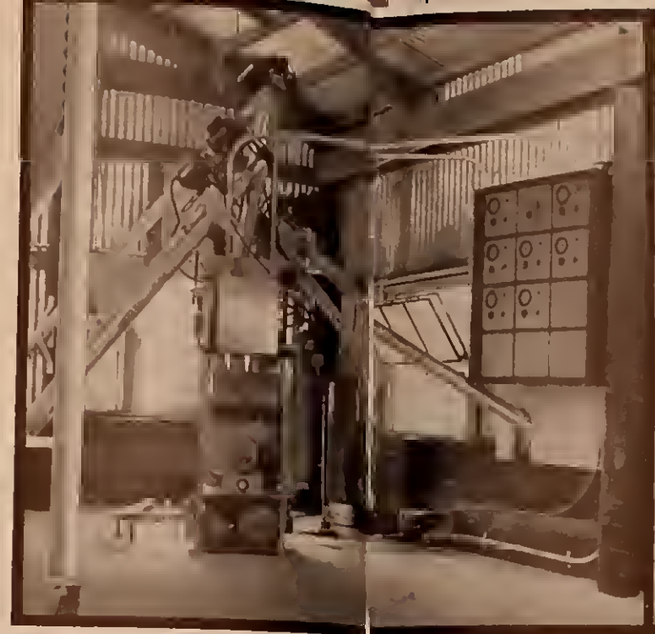
Sulfur-bearing fertilizers less subject to leaching should be investigated, scientists say. A comparison of losses by elemental sulfur versus gypsum is now underway. ☆



Distribution control panel (above) contains a subassembly for each feeding location. After grinding and blending, feed can be automatically moved to the selected discharge point.

AUTOMATION ON A POULTRY FARM

Feed mixing, grinding, moving done by electrically controlled equipment



Mixing and grinding of ingredients into complete rations are done by hammermill supplied by automatic bulk storage bin unloaders. Compressed air tanks supply medium pressure needed for conveyance.

Air view shows convenient plan of Frye farm. Feed ingredients are stored in bulk bins (a). Center of system is in unloading, storage, and processing building (b). Feed moves through pipes to turkey and poultry houses (c).

Pipe (a) carries feed into poultry house. Three-way pinch valve (b) may direct feed to storage bin (c) or permit it to continue to another discharge point. Auger-feeders (d) supply feed at set intervals.

Three-way pinch valve, operated by compressed air and electrically controlled, is suitable for automatic direction control of feed movement.

■ Completely automatic handling of feed for poultry—from bulk storage bins to feeders—has been developed in research by a USDA agricultural engineer cooperating with Illinois Agricultural Experiment Station scientists and an Illinois farmer.

The researchers have devised experimental equipment and adapted commercial machines to blend, grind, convey, and distribute feed automatically. The facilities are operated and controlled electrically and maintain a constant supply of feed in poultry houses.

Bulk feed is blended and ground in a commercial, automatic electrical hammermill. Feed is then moved to poultry houses by a pneumatic conveying system as easily as water can be piped—up, down, and around corners.

H. B. Puckett, ARS agricultural engineer at Urbana, was chiefly responsible for the design and adaptation of the electrical devices used to operate the facility.

This experimental system was installed last year on the farm operated by W. T. Frye in Peorin County. Since June 1959, when automatic equipment was added to the hammermill, approximately 700 tons of feed have been put through the system. All feed except commercial pelleted premix is grown, stored, and processed on the farm. About 14,000 turkeys and 29,000 broilers are raised and processed for market annually.

The system is paying off. The conveyor alone saves the wages of a part-time worker to distribute feed. Frye and his help are free for other farm tasks because of the increased efficiency and convenience from a feeding system capable of 24-hour-a-day automatic service.

This low-volume, medium-pressure, pneumatic conveying system is growing in popularity for industrial conveying because of the small-size pipe required, the ease of installation, the automatic controls, and the small amount of dust generated at discharge stations.

Frye's conveyor can move 1,200 pounds of feed per hour a distance of 390 feet with 32 cubic feet of air per minute under pressure of 7½ pounds per square inch.

Bulk storage holds ingredients for four rations

Eight bulk storage bins hold ingredients used to make four basic rations. The bins are automatically unloaded by augers into meters of the hammermill. After grinding and mixing, the feed is discharged into an airlock—similar in principle to a revolving door—that places it in the pneumatic conveyor. Then the feed is blown through 1-inch pipe, partially underground, to small storage bins at discharge stations in the poultry houses. Here the feed is distributed at set time intervals by automatic feeders—maintaining a constant supply of freshly ground feed for the birds.

Dials at hammermill control type of mix produced

The entire system can be controlled by a bin switch at each feeding location, or by a manually set interval timer at the control panel near the hammermill. The type of mix to be delivered to each location can be controlled by setting dials located on the hammermill.

One of the keys to the success of this system is the three-way pinch valve located at several places along the pipeline. Each valve is equipped with two branch pipe outlets, each of which can be opened or closed automatically to route feed to different locations.

Especially built by Puckett for this system, the valve consists of a metal tube with a collapsible rubber liner. The tube and liner work like a milking machine teat cup and liner. Compressed air is injected between the tube and liner, forcing the liner to collapse and divert the feed to the other outlet. ☆

Exposure to cold rain and wind after birth in December and January often kills 30 to 40 percent of the newborn lambs in northern California. But researchers find that

Low-Cost Shelter Saves Lambs

Pole-type, plastic-roofed range shelters (built for about 7 to 10 cents a square foot) could be used successfully in other cold and wet climates.

A 27- by 48-foot shelter was built in only 31.2 man-hours by workers at the Hopland Field Station. Materials were precut and prefabricated in farm shop.

Adhesive is applied under plastic where it contacts frame. Nailing strips and framing are rounded and smoothed to avoid punctures in plastic.

■ A plastic-roofed range shelter not only kept many newborn lambs alive but was inexpensive, easy to build, and simple to maintain in experiments of State and USDA researchers.

Roofed with black polyethylene, the open-sided pole-type shelter greatly reduced usually large losses of lambs that are born on the coastal range of northern California. These animals die from exposure to cold rain and wind, mainly at night, after birth in December and January.

The shelter can be built in the California area for only 7 to 10 cents a square foot of floor space. And 1 lamb saved per 100 born can pay ranchers the annual cost of maintaining a 27- by 48-foot shelter.

Researchers believe the shelter can be built inexpensively and used successfully in similar climates. But they suggest tests before ranchers use the shelter in other areas.

Lamb losses average 30 to 40 percent—and sometimes are 90 percent in severe winter weather—unless shelters are provided on the fenced sheep breeding ranches of northern California. About $15 is received for each lamb sold there.

Animal husbandman D. T. Torell and agricultural engineer C. F. Kelly, of the California Agricultural Experiment Station, and ARS agricultural engineer Thayer Cleaver designed the shelter. Work was done at California's Hopland Field Station.

Four advantages are cited

The researchers cite four advantages of the shelter over more costly conventional structures:

1. Less money is tied up in a building and can be used other ways.

2. Interest that would be paid on the investment in a conventional shelter might pay annual costs for a plastic-roofed shelter.

3. Such a shelter can be depre-

iated in 1 or 2 years for income tax urposes. Most farm buildings are epreciated over 10 to 20 years.

4. Property taxes should be lower ecause of a temporary real estate lassification on the shelter.

For most efficient use of an abunant supply of forage in March and April, northern California flocks are anaged for lambing in December nd January. This is the coldest and ettest time of year—average temeratures range from 32 to 58 and ost of the annual average of 35 nches of rain falls. Snow storms arely occur. (But the plastic—6-milhick polyethylene was used—could upport moderate amounts of snow.)

Other shelters not profitable

Conventional lambing shelters genrally are too expensive for profitable se on California's small family-size anches of 300 to 500 breeding ewes. Money spent for the shelters, extra andling labor, and feeding in the uildings can be lost if the lamb market is not good.

Of the 7 to 10 cents per square foot or constructing the plastic-roofed helter, framing takes 2 to 4 cents based on a retail price of $60 to $120 er thousand for lumber). Plastic is bout 3 cents, and labor 2 to 3 cents a foot.

Workers at the Hopland station uilt a 27- by 48-foot shelter in only 31.2 man-hours. Costs were kept lown by precutting and prefabricating materials in the farm shop.

Figuring 10 square feet of shelter for a lamb and ewe, the researchers set the annual cost at 20 to 30 cents per pair of animals. Shelter maintenance mainly involves repair of occasional punctures or wind tears. Plastic replacement costs about 2 cents a square foot, but is necessary only every 2 to 3 years if the covering has been properly applied. ☆

WATER SPREADING FOR MORE AND BETTER FORAGE

■ Returns from extra forage produced by water spreading, an ancient irrigation practice still used profitably in the dry West, can be several times greater than annual maintenance costs.

This was indicated in studies by ARS range conservationist W. R. Houston. Average yields of blue grama grass more than tripled and those of western wheatgrass almost doubled after runoff water from heavy rain was diverted to flood rangeland near Miles City, Mont.

In earlier experiments, scientists noted that one range produced up to *34 times* more forage when flooded than when not flooded. In Houston's studies, yield increases varied from 38 percent for western wheatgrass to 648 percent for blue grama grass—depending on duration of flooding and how well the land was irrigated.

Water spreading was probably the first form of irrigation used in Old World farming. It's likely that it began in this country when the first Western settlers diverted water with ditches and dikes.

Obvious benefits of the method—improved yields and quality of forage—are well recognized, but little was known about costs and returns. Research by Houston and others is providing this information. His work, conducted in 1955, 1957, and 1959 in cooperation with ARS animal husbandmen and scientists of the Montana Agricultural Experiment Station, was a continuation of studies by USDA's Forest Service.

Several additional advantages of water spreading are earlier and longer grazing, better response to fertilizer, an increase in litter cover (organic matter), restoration of ground water levels, and use of the diverted water by livestock.

Scientists figure water spreading costs and returns

What does water spreading cost? According to Houston, the initial costs have varied from 36 cents to $30 an acre. Montana station scientists report that $1,649 ($1.38 an acre) was spent on ditches and dikes in the 1,200-acre area where Houston conducted his experiments. Accumulated maintenance costs were $465, making the total $2,114.

By prorating this total over 900 acres used in his studies, Houston arrives at a per-acre cost of $2.35 or 29 cents an acre a year for the 8 years the spreading system has been operated.

What does water spreading pay annually? Houston's figures show that spending 29 cents an acre doubled or tripled average yields and increased gross income $2 to $3 an acre—a 7- to 10-fold return.

Several factors are considered in establishing a water-spreading system, notes Houston. Among these are type, slope and depth of soil, amounts and kinds of soil salts, size and slope of the watershed, storms that encourage flooding, and whether the water contains excess silt to inhibit grass growth or fill the spreader system. ☆

Researchers have found that lupine plants and lead are involved as we narrow the search for the cause of

CROOKED CALF DISEASE

■ The cause of crooked calf disease—a congenital deformity of newly born calves resulting in twisted, deformed legs—has been narrowed down to two elements in south-central Idaho studies.

USDA scientists were able for the first time to experimentally produce a typical crooked-leg calf under controlled conditions by feeding small daily amounts of lead for 120 days along with the lupine plants normally grazed. Further studies are underway to determine if the causative factor is lupine or lead, or perhaps a combination of both.

These studies are being conducted by ARS veterinarian Wayne Binns and biochemist L. F. James at Logan, Utah, in cooperation with the Utah Agricultural Experiment Station and ARS nutritionist K. C. Beeson of the U.S. Plant, Soil, and Nutrition Laboratory, Ithaca, N.Y.

Twisted front legs of 12-day-old calves are typical of crippling caused by the disease.

The deformity, which occurs primarily in offspring of cattle grazing certain alpine ranges in south-central Idaho, affects mostly the legs and spine. It varies from slight bowing to marked and persistent flexing and twisting of one or both front legs. A stiff neck and curvature of the spine may or may not be present.

Although the disease occurs among the Hereford beef cattle predominant in the area, it also occurs in dairy breeds grazing on the summer ranges along with the beef animals.

The deformity has also been reported in Montana, Washington, Oregon, Nevada, California, Australia, Canada, and South Africa. Livestockmen at first thought the deformity was caused by a hereditary factor. But as more accurate breeding records were kept, it soon became obvious that heredity wasn't to blame.

Studies of suspected range areas have been underway since 1955 to see if the malformation is caused by a nutritional deficiency or by ingestion of a toxic substance. Scientists wanted to know, too, when the damage or "insult" to the fetus occurred.

Soil has high mineral content

There were no marked mineral deficiencies in the area. Examination of water samples showed none of the generally recognized toxic elements. But the area *is* highly mineralized and has been extensively mined. So the scientists decided to test the effects of certain minerals the animals might have gotten from small grazing areas that could have been missed in random plant samplings. Lead was selected as the first mineral to be fed because of its possible effect on phosphorus metabolism.

Scientists decided also to test the effects of feeding lupine (*Lupinus sericeus*) as animals in this area graze heavily on these plants in late fall. *L. sericeus* was collected in the early seed stage from a suspected range area and fed to an 18-month Holstein heifer with 5 milligrams of lead (as lead acetate) per kilogram of body weight. Starting dosage of lupine was 1 pound daily, increasing ¼ pound every third day until the toxic dose was established—1½ pounds daily. The feeding trial was started on the day of breeding and continued for 120 days.

The calf was born dead in a breech position at 287 days gestation. Both front legs were flexed at the knee and elbow joints, in a fixed position, with the bones turned outward at a 45-degree angle. Postmortem examination showed no significant changes other than those connected with the skeletal system. These deformities were typical for the most severe cases of crooked calf disease observed in the field.

A study of range operations showed the deformed calves were born during March and April, coming from a June or July breeding. Thus, the damage to the fetus most likely occurs between 60 and 90 days of gestation, at the time when most of the bones are developing into their final form and hardening. This is at the height of the grazing season when lupine plants are grazed heaviest.☆

CHEMICALS REDUCE URINARY CALCULI

There's no easy or sure cure for cattle suffering from urinary calculi or stones in the bladder or urinary tract. But continuing State-USDA studies are giving us a clearer picture of how we can help affected animals and possibly prevent stone formation.

Three-year tests just completed in the Southwest indicated the usefulness of two chemicals—ammonium chloride and phosphoric acid—in controlling stone formation in this area. (Unfortunately, a treatment effective in one area may not be effective in another area due to differences in soil minerals and feed.) Also tested was hyaluronidase—an enzyme commonly used to treat humans suffering from the same disorder. But it wasn't effective in the amounts used in these tests.

None of the compounds used had any effect on appetite, feed consumption, or carcass quality.

These studies—only part of long-range research on urinary calculi in many parts of the country—were conducted by animal husbandmen and soil specialists of USDA and the Texas Agricultural Experiment Station at the ARS Big Spring Field Station, Texas.

Urinary calculi—found in the kidney and urinary tract of cattle, sheep, mink, and some other animals—are thought to be caused by some nutritional or metabolic disturbances. The stones often occur rather commonly in steers in the Southwest, especially in animals fattened on milo grain, cottonseed meal, and sorghum silage. Stones often collect in the urethra, blocking or interfering with the flow of urine and frequently resulting in a ruptured bladder. The urine then collects in the body cavity and the characteristic swelling gives rise to another name for the disorder—water belly.

Eight lots of eight steers each were used each year. Four lots were given ground milo grain, sumac silage, cottonseed meal, and alfalfa hay. Cottonseed hulls replaced a small part of the silage in the other four lots.

One lot on each ration got no supplement. A second lot received two injections of hyaluronidase. A third lot was given ammonium chloride daily in the ration, and a fourth lot, phosphoric acid. Steers were slaughtered when the feeding period was completed and the bladders were examined for urinary calculi.

Both ammonium chloride and phosphoric acid reduced stone formation, while hyaluronidase had no effect. More frequent injections of this enzyme might be effective, but it wouldn't be practical for commercial feeders or ranchers because the other compounds are cheaper and easier to use. More work needs to be done to determine how much phosphoric acid and ammonium chloride should be given and for how long.

The small amount of cottonseed hulls used to replace part of the silage had little effect on stone formation. Although hulls have a high silica content and are thought to cause stones, they contain less silica than silage and might be expected to reduce incidence of stones when they replace silage. This wasn't the case, however. No definite conclusions can be drawn on use of hulls, though, because data were so limited.

Work is now underway to find the dietary elements responsible for the formation of stones. Older chemicals and several new ones are being checked to test their usefulness in stopping stone formation. ☆

Heat penetration during cooking for different periods by various methods was measured by thermocouples in stalks.

How to Cook Broccoli

Preservation of flavor and nutritive value is key to getting the most out of our green vegetables

■ Green vegetables such as broccoli that supply important nutrients need careful cooking to develop and preserve their good flavor and nutritive value. Broccoli, which has grown in popularity in the last few years, presents more problems in cooking than most other green vegetables because of the presence of strong-flavored sulfur compounds as well as of unstable chlorophyll pigment.

To discover the best procedures for boiling and steaming, and for pressure and electronic cooking, USDA food scientists in the ARS Institute of Home Economics studied the chemical and physical changes that occur during heating of broccoli. Color and texture were evaluated by a taste panel and by objective tests. Flavor was evaluated by panel score.

Broccoli is at its best when it is tender but holds its shape, has a palatable, well-developed flavor, and retains as much as possible of the original color, vitamins, and minerals. The researchers found that both fresh and frozen broccoli had desirable flavor when boiled, steamed, or pressure-cooked to the point that gave the best texture.

Texture of stems was considered to be of primary importance in evaluating the cooking methods. In general, there was fairly good retention of color and ascorbic acid in broccoli cooked to optimum texture.

Fresh broccoli improved in texture with up to about 10 minutes of cooking at atmospheric pressure. At 5 pounds pressure, about 5 minutes of cooking was needed to make broccoli tender; at 15 pounds pressure, about 2 minutes was needed.

No quality loss in freezer

Frozen broccoli from two 10-ounce packages required about the same cooking time by boiling and steaming methods as 16 ounces of trimmed fresh vegetable. When cooked at 15 pounds pressure, frozen broccoli was not uniform in color and tenderness. Storing freshly processed frozen broccoli for 9 months at 0° F. did not appear to affect its quality.

Fresh broccoli retained its color slightly better when cooked on a home-type *electronic* range than when boiled. However, flavor was about the same for broccoli cooked to optimum texture by these two methods. Electronic cooking favored retention of ascorbic acid in both fresh and frozen broccoli.

Most color and nutrient losses during conventional cooking were caused by substances leaching out in cooking water, the losses increasing with large amounts of water. Losses of ascorbic acid from fresh and frozen broccoli cooked to optimum tenderness in a small amount of water were similar—from 20 to 30 percent.

Vitamin C losses studied

The frozen broccoli lost most during the first 5 minutes, whereas losses from the fresh vegetable were more gradual and continued throughout the cooking period. Fresh broccoli, however, had more ascorbic acid to begin with than frozen broccoli as some is lost during the blanching and freezing process.

Carotene was concentrated chiefly in the green outer portion of the stems, and larger heads contained more than smaller, less mature ones. Heating did not destroy carotene.☆

Research expansion urged

Expansion of research in 11 general areas was recently advised by USDA's Agricultural Research Policy Committee in Washington, D.C.

The policy committee recommended special emphasis on learning more about food nutrients, quality, and consumption, U.S. dietary levels, and factors in nutrition.

Additional suggestions by the committee included wider research on:

1. Prevention of undesirable chemical residues in soil, plants, animals, feed, and food products.

2. Development of replacement crops as profitable substitutes for some of the wheat, cotton, and other crops now in surplus.

3. Finding new or expanded industrial uses for surplus farm products.

4. Farm costs and returns to help farmers adjust to changing price-cost relationships, technology, and changing markets.

5. Livestock breeding and improved performance testing of animals to provide livestock with superior characteristics for the production of meat, milk, eggs, and wool.

6. Plant breeding to develop improved high-quality crops that will

resist diseases, insects, and other natural hazards—while being adapted to many environmental conditions and mechanized production.

7. Water conservation to prevent losses and conserve the supply.

8. Forests and rangelands to enhance recreational values without impairing their value for supplying water and for timber, wildlife, and livestock production.

9. Measurement and evaluation of market quality to improve inspection, grading, and standardization.

10. Improving income and employment for farm and rural nonfarm families in low-income areas.

Members of the committee are appointed by the Secretary of Agriculture under provisions of the Research and Marketing Act of 1946. Represented are farmers and ranchers, State and private research organizations, and industries.

Two house plans released

Two new house plans—featuring a research-developed kitchen and spacious, flexible room arrangement—have been released by USDA.

Both of these designs employ masonry and frame construction and a low-pitched roof. Each house plan offers a carport. One design (Plan 7149) includes a basement under the main living area and a covered patio. The other (Plan 7152) is designed for construction on a concrete slab and has no patio.

These plans contain the Beltsville Energy-saving Kitchen Design No. 2 (AGR. RES., November 1959, p. 8). The kitchen design incorporates results of research on work space, storage, and kitchen arrangements that require minimum effort.

Although intended basically as farm homes, they are suitable for use in many suburban and urban locations. ARS architects and housing specialists developed the plans.

Working drawings are available through farm building specialists in the agricultural engineering departments of most State land-grant colleges or universities.

New control for curculio

Treating the soil under peach trees with insecticides controls the plum curculio and may eventually replace tree spraying, USDA entomologist O. I. Snapp reports.

The adults of the plum curculio (*Conotrachelus nenuphar*) winter in trash or other protected places in and about the orchards. They normally move to the trees about flowering time. These adults later lay eggs in the newly set fruit. The eggs hatch into grubs that feed in the fruit until full grown, then leave the fruit and enter the soil to complete their development. When an insecticide was mixed with the top layer of soil early in the spring in tests at Fort Valley, Ga., the subsequent broods of larvae were killed.

Aldrin, dieldrin, and heptachlor were equally effective in the tests, one application preventing successful

emergence of plum curculio adults for several years.

In one field test, aldrin granules were spread under Elberta peach trees in March 1957, and no further treatment was given. Only 1.6 percent of the harvested fruit was infested in 1957, 2.9 percent in 1958, and 0.7 percent in 1959. Some of the infestation may have come from beetles outside the treated orchard.

Aldrin was mixed with fertilizer and spread under several thousand trees in March 1958, in a cooperative experiment with a Georgia peach grower. The material was broadcast by hand and disked into the ground. No wormy peaches were found in the

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1958 harvest and in 1959 the owner found wormy fruit in only one small area of the orchard. In contrast, peaches in a neighbor's untreated orchard were ruined by the pest.

The plum curculio also attacks plums, cherries, and apples.

Heat may not kill virus

Some of the secrets of the foot-and-mouth virus are being unfolded by USDA scientists at the Plum Island Animal Disease Laboratory.

In recent studies it was found that the disease-producing portion of the foot-and-mouth virus—the ribonucleic acid core—may be more resistant to destruction by heat than was previously believed to be the case.

Earlier work had shown that the disease-producing ability of the foot-and-mouth virus was destroyed by heating to 140° F. or higher. However, ARS biochemist H. L. Bachrach has now found that such heat treatment only seals the infectious core within the protein covering of the virus and in this way blocks its ability to infect susceptible animal cells.

He found that once the protein covering was chemically removed, the sealed-in cores were still infectious. In fact, infectious cores could be obtained from virus that had been boiled for as long as 5 minutes.

For these reasons, the scientist concludes, the foot-and-mouth virus may be more dangerous than previously considered because nature may have ways of matching his chemical method of releasing the infectious core of the heat-treated virus.

Scientists have also concluded that meat from foot-and-mouth infected animals is not rendered virus free by the usual procedures of ripening, boning, salting, and storage. The virus could survive in residual blood or lymph nodes of boned, salt-cured meat for at least 50 days, and in bone marrow in refrigerated carcasses for at least 73 days. Under some circumstances, food refuse containing such parts might become sources of infection to meat animals.

Vinall produces more seed

Vinall, a new Russian wildrye that has better seed-producing ability than present commercial wildrye, has been released by USDA and seven Western State experiment stations.

Commercial Russian wildrye is a good perennial pasture grass, but its relatively light seed production has restricted its use. Vinall should help increase use of Russian wildrye as a pasture grass.

Vinall also resists lodging and produces larger seeds than commercial wildrye. Larger seeds produce stronger seedlings, aiding establishment. All tests indicate that seed quality and forage production have not been sacrificed in selecting the new variety for high seed yield.

Vinall was developed at the Northern Great Plains Field Station, Mandan, N. Dak., by ARS agronomists G. A. Rogler and H. M. Schaaf.

Gain in Bang's campaign

A screening-type blood test of cull and dry cows on the way to or during slaughter is resulting in great savings to beef producers in efforts to eradicate brucellosis (AGR. RES., May 1959, p. 8).

Successful use of the test to recertify Benton County, Wash., as a modified-certified brucellosis area marked a major advance.

The milk ring test has enabled dairy producers to make faster progress than beef producers toward the national goal of brucellosis eradication. Now, however, beef producers can maintain modified-certified status by using this new method developed as a part of the State-Federal cooperative brucellosis eradication effort.

Animals tested annually must equal 5 percent of all cows in the area. Another important requirement is that owners vaccinate at least 80 percent

of all eligible calves each year.

This system permits a reduction in ranch testing, thus saving the majority of beef producers the expense and labor of handling cattle, as well as eliminating the possibility of injury to the animals. Since all herds in an area may be included in this continuous screen testing, any infection is likely to be detected before it has opportunity to spread.

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